Space Weather Technical Forecast

Issued on Saturday, 27 August 2022 at 01:14 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: M-class flares Likely. Active electron fluence probably waning.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was Moderate, with the background X-ray trace at GOES16 well into C-class levels. There were numerous M-class flares including several in a short period of time, starting with an M7 flare (the largest of the period) at 26/1215 UTC. Most of these flares arose from sunspot region 3089 (Dac/Beta-Gamma-Delta) in the southeastern quadrant, which is showing a sharply-defined magnetic neutral line. There was another notable sunspot in the southwestern quadrant, AR3088 (Dkc/Beta), which has produced several C-class events and may have contributed to the M-class flaring around 26/1315 UTC. A probable CME from this event was seen in AIA-094 imagery, but subsequent coronagraph imagery shows a series of westward travelling CMEs which appear to be mostly far sided. Analysis is still ongoing, but any significant Earth directed component appears unlikely at the present time.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, was at background levels through the period. The wind speed varied between 320-370 km/s. The density was at average or below average levels, but has been on a slight rising trend. The IMF, Bt, was weak below 7nT, while the north-south component, Bt, ranged weakly between +5 and -4nT. The phi angle was negative (towards the Sun) throughout. Geomagnetic activity was Quiet throughout.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured by GOES-16, was at Background levels. The high energy electron flux (greater than 2 MeV) remained at High levels, with a peak of 3600pfu at 26/1810UTC. The 24-hour integrated electron fluence remained above the Active threshold (1e8 integrated pfu) on a steady trend, with 1.83e8 integrated pfu observed at 27/0001UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Further M-class flares are likely with a slight chance of an X-class flare. A gradual decrease is likely later in the period as AR3088 departs, although AR3089 should remain present throughout (barring development). No new regions of note are due.

Solar Wind / Geomagnetic Activity: Earth-directed CMEs are currently considered unlikely. There are two coronal holes which will affect the current forecast. CH18/+ is a small feature which may give a minor enhancement to slightly elevated levels around 400-450 km/s. It is a positive coronal hole which may give a slightly stronger geomagnetic response at this time of year, although it is still a weak feature. This will probably be overtaken by the HSS from CH17/-, which is likely to arrive during Day 2 (28 Aug), with wind speeds around 500-600 km/s, but is likely to have a more muted geomagnetic response at this time of year.
Geomagnetic activity is expected to be Quiet to Unsettled, with a chance of Active intervals with the onset of both CH18 and then CH17, and just a very slight chance of G1/Minor Storms.

Energetic Particles / Solar Radiation: There is a slight chance of proton flux (greater than 10

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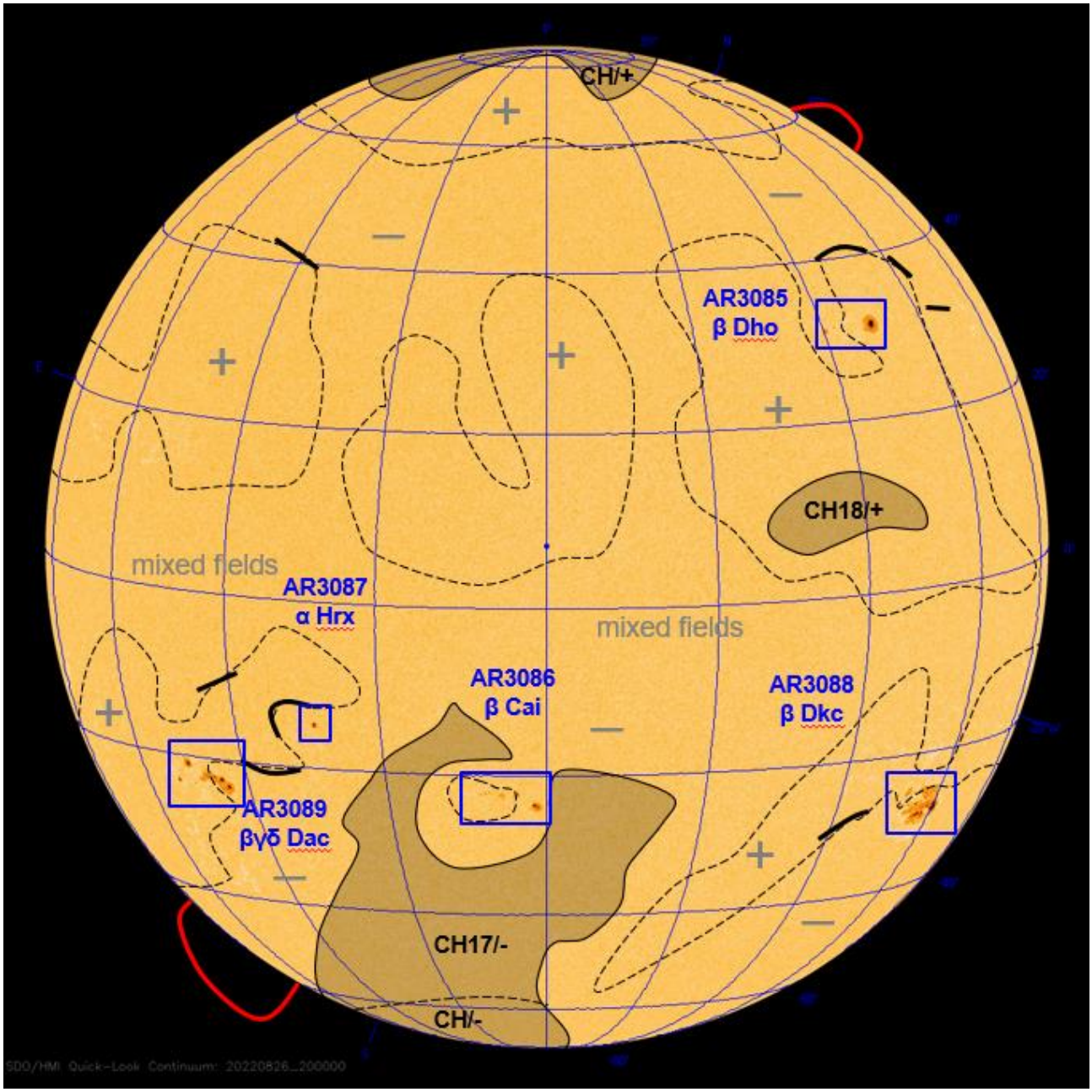
MeV) reaching S1 or greater, due to AR3088 and AR3089. This risk increases very slightly for Days 2 and 3 (28-29 Aug), before declining again as 3088 rotates away.
The high energy (greater than 2 MeV) electron flux may see a reduction as CH18 and CH17 arrive, although it is possible that the geomagnetic activity will be insufficient to cause a significant drop. Further charging may then occur from CH17. The current Active (greater than 1e8 integrated pfu) fluence levels may drop below the Active threshold in the next couple of days, with an increase then possible later in the period.

Figure 1. Solar Analysis Valid 26/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Earth-directed CMEs are considered unlikely, although there is still analysis ongoing to examine the slight risk of a glancing blow from a potential CME emitted by AR3088 around 26/1315 UTC.

There are two coronal holes on the disc which are the main features of interest at the present time. CH18/+ is a small feature which may become geoeffective during Day 1 (27 Aug), but is likely to only give a minor enhancement to slightly elevated levels around 400-450 km/s. It is a positive coronal hole which may give slightly enhanced geomagnetic effects due to the fact we are less than a month from the September equinox where positive holes have a stronger geomagnetic response, but it is still a weak feature. This will probably be overtaken by the HSS from CH17/- which is an extension of the southern polar crown. This is a larger feature although its relatively low solar latitude, compared to Earth nearing its maximum distance north of the solar equatorial plane, combined with a more muted geomagnetic response from negative holes at this time of year, makes effects potentially more marginal. STEREO appears to have seen a recent enhancement which may correlate with this feature, suggesting an arrival during Day 2 (28 Aug), with wind speeds around 500-600 km/s.

Geomagnetic activity is expected to be Quiet to Unsettled, with a chance of Active intervals with the onset of both CH18 and then CH17, and just a very slight chance of G1/Minor Storms.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	5	5	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
*	*	*	*	*	*	*

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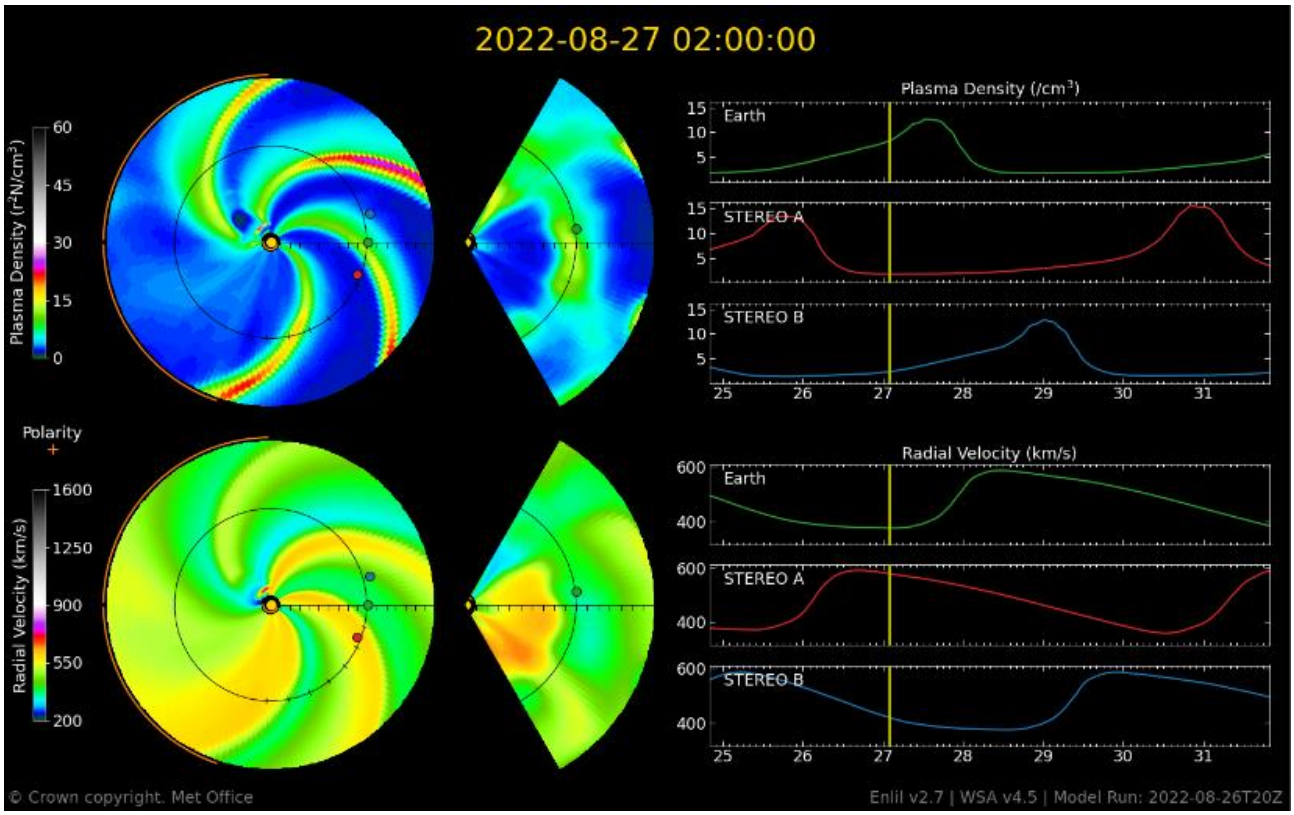
Figure 2: MOSWOC Enlil showing a rise in wind speed, likely associated with CH17, later on Day 1 (27 Aug). This is probably just a little too early with the rise currently expected on Day 2 (28 Aug) but otherwise it shows a good trend.



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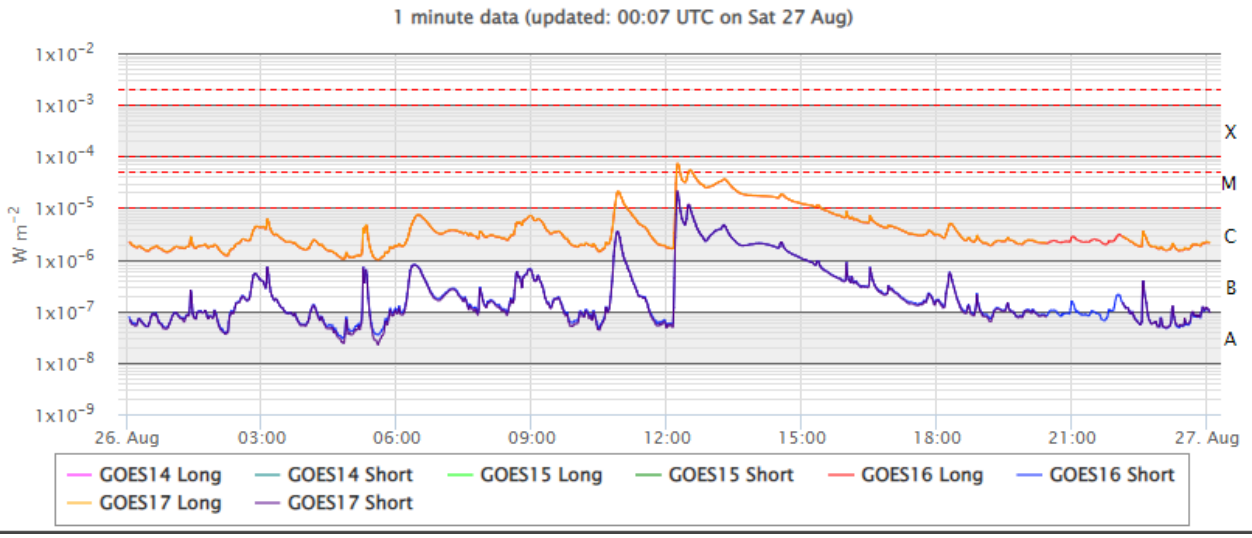
Radio Blackouts - X-Ray Flares:
Solar activity has been Moderate over the past 24 hours, with numerous M-flares mainly from AR3089 in the southeastern quadrant, but perhaps with some contribution from AR3088 in the southwestern quadrant. Both of these regions have sharply-defined magnetic neutral lines with a latitudinal orientation, which may give a degree of shear instability, as well as being relatively compact (especially AR3088). AR3089 also retains a small delta spot. The other regions are relatively simple and are less of a flare risk. M-flares are considered likely, with a slight chance of X-flares.

Regarding the balance of front-sided groups, AR3088 should depart the visible disc during Day 3 (29 Aug), although some risk from this feature is maintained into Day 4 (30 Aug) until it is well past the limb. On the eastern solar horizon, neither far-side soundings nor STEREO A EUVI 195 imagery suggest that there is anything imminent arriving, and so the overall trend in flare risk is slightly downwards as AR3088 departs.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	50	50	50	40
Very Active	R3 to R5 X Class	No	10	10	10	5

Figure 3: Flares in the last 24 hours, peaking at M7 from AR3089.



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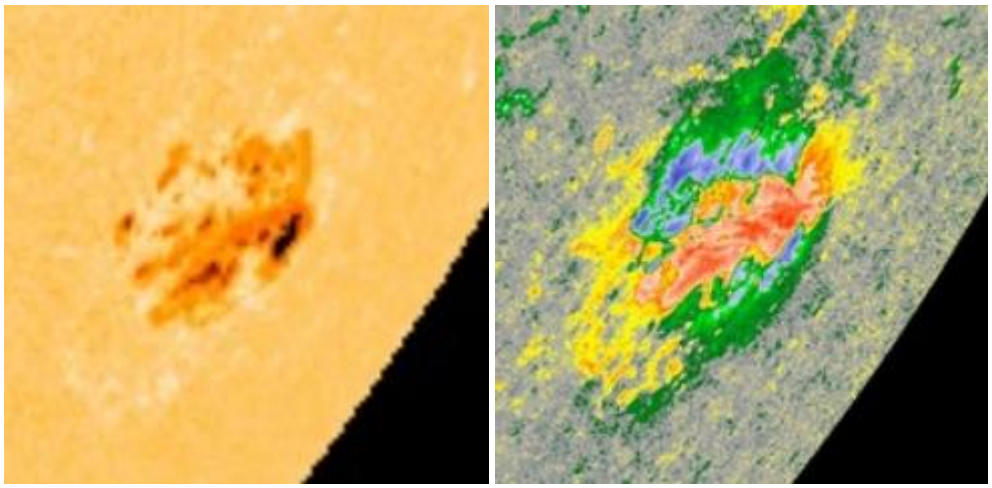
Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) is currently just very slightly enhanced above normal background levels following the M7 flare at 26/1215 UTC, but well below S1 levels. Given the complexity of AR3088 in the southwestern quadrant, there is a slight chance of solar radiation storms, with this bolstered by AR3089 in the southeast especially as it transits westwards. Neither has a recent history of significant proton enhancement, but both have developed their complexity in the last couple of days, giving only a short history.

AR3088 should leave the disc on Day 3 (29 Aug), however it will contribute a declining amount from over the limb into the following couple of days, with the risk from AR3089 also rising as it moves westwards. As such there is a slight increase in probability for Days 2 and 3 (28-29 Aug), before it declines again as AR3088 rotates away.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	15	15	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: AR3088 (top) and AR3089 (bottom), both showing some complexity.



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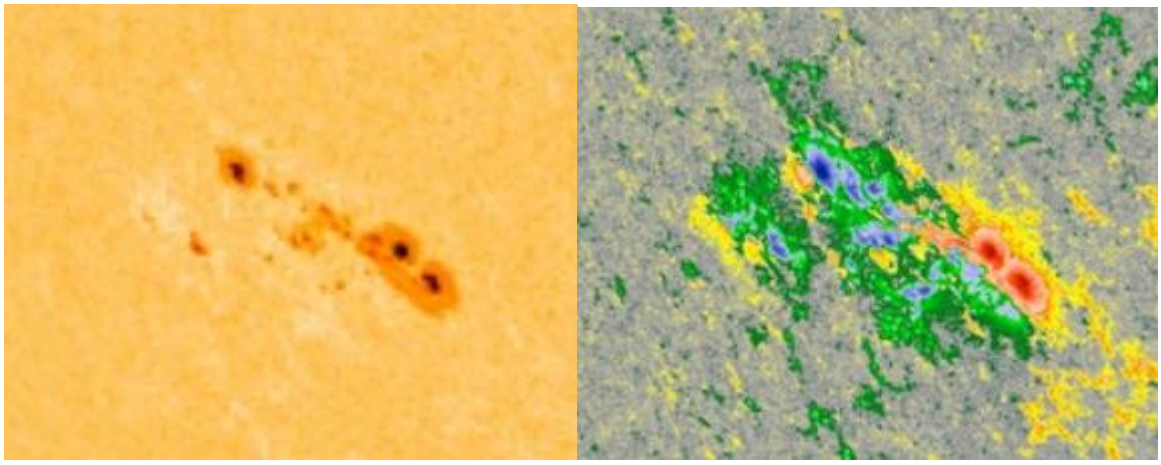

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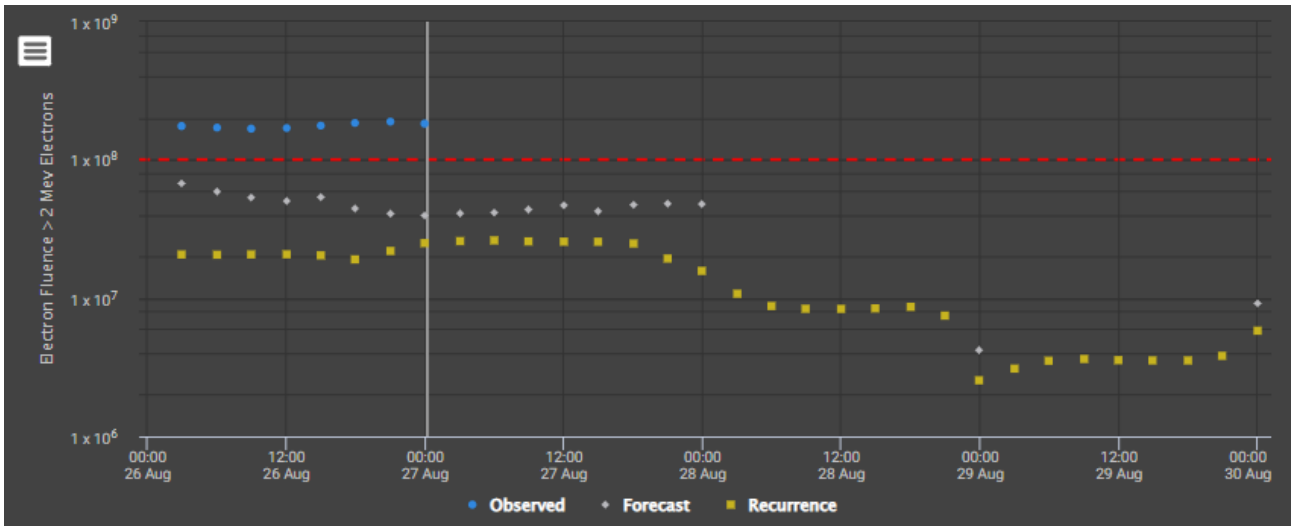
High Energy Electrons Event (≥ 2MeV):
The high energy (greater than 2 MeV) electron flux, as measured by GOES16, has been High throughout the last few days, although the high speed stream that generated current flux levels has waned. Some minor geomagnetic activity is possible from CH18 and then CH17 in the next couple of days. This may give a reduction in electron counts, although it is possible that the geomagnetic activity will be insufficient to cause a significant drop. Further charging may then occur, especially from the HSS from CH17.

The current Active (greater than 1e8 integrated pfu) fluence levels may drop below the Active threshold in the next couple of days, but this is dependent on the level of geomagnetic activity seen from the coronal holes. An increase is then possible later in the period as CH17 starts to wane. MOSWOC REFM is currently under forecasting fluence levels.

GEO Electron Environment	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	70	40	50
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	1	1	1

Figure 5: MOSWOC REFM is currently under forecasting fluence levels.



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